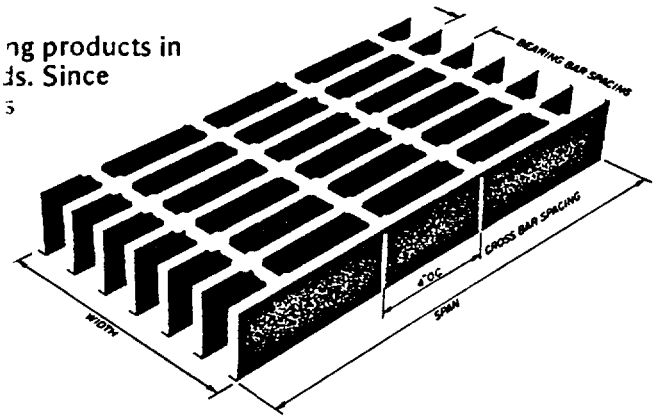
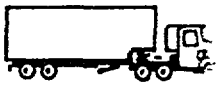
GPI

Grating
Pacific
Inc.

HEAVY DUTY GRATING

Heavy-duty gratings often meet the need for flo ng products in roadway and factory areas subject to vehicular l ds. Since conditions can range from light-duty forklift tru s to semi-trucks and trailers carrying maximum allowable highway loads, heavy-duty gratings are manufactured in a wide variety of bar sizes and spacings. The most popular products are described on the following pages along with tables showing the maximum safe spans for some of the most common vehicle loads. If your particular situation is not covered in these tables we would be pleased to assist in the selection of a heavy-duty grating for your specific needs.

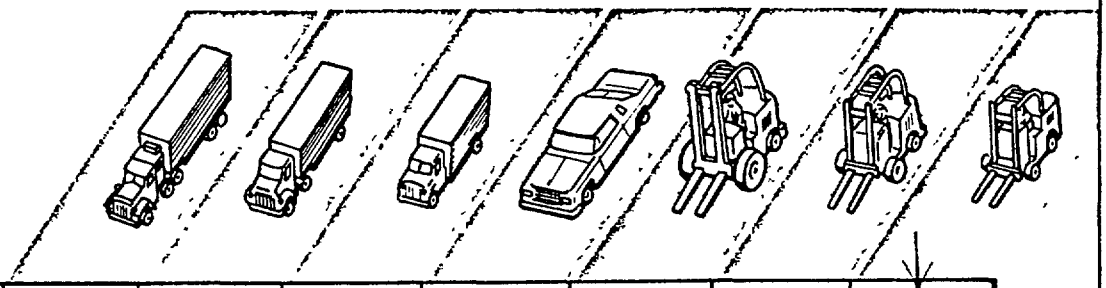


MAXIMUM TRAFFIC CONDITIONS	WHEEL LOAD (LBS.) (½ OF AXLE LOAD +30% IMPACT)	LOAD DISTRIBUTION PARALLEL WITH AXLE	LOAD DISTRIBUTION PERPENDICULAR TO AXLE
Truck Traffic 32,000 Lb. Axle Load Dual Wheels Modified AASHTO H-20 	20,800	2 (C) + 20" *	15"
Truck Traffic 24,000 Lb. Axle Load Dual Wheels AASHTO H-15	15,600	2 (C) + 15" *	15"
Truck Traffic 16,000 Lb. Axle Load Single Wheels AASHTO H-10	10,400	2 (C) + 10" *	10"
Automobile Traffic 5000 Lb. Vehicle 1200 Lb. Load 55% Drive Axle Load	2,220	2 (C) + 8" *	8"
10,000 Lb. Cap. Lift Truck 14,400 Lb. Vehicle 24,400 Lb. Total Load 85% Drive Axle Load	13,480	2 (C) + 11" *	11"
6,000 Lb. Cap. Lift Truck 9,800 Lb. Vehicle 15,800 Lb. Total Load 85% Drive Axle Load	8,730	2 (C) + 7" *	7"
2,000 Lb. Cap Lift Truck 4,200 Lb. Vehicle 6,200 Lb. Total Load 85% Drive Axle Load	3,425	2 (C) + 4" *	4"

*C = CENTER TO CEN SPACING OF BEARING BARS

ALLOWABLE STRESS – 20,000 PSI
MODULUS OF ELASTICITY – 29,000,000 PSI
MAXIMUM DEFLECTION – 1/400 OF SPAN

BEARING BARS 1-7/8" ON CENTER, CROSS BARS 4" ON CENTER



BEARING BAR SIZE	WT. LBS. PER SQ. FT.	SECTION MOD. PER FT. OF WIDTH	H-20 TRUCK	H-15 TRUCK	H-10 TRUCK	AUTO TRAFFIC	5 TON FORK LIFT	3 TON FORK LIFT	1 TON FORK LIFT
			MAXIMUM SAFE SPAN						
1 x 1/4	6.6	.286	0'-9"	0'-9"	0'-7"	1'-1"	0'-7"	0'-6"	0'-6"
1 x 5/16	8.3	.354	0'-9"	0'-10"	0'-7"	1'-3"	0'-7"	0'-6"	0'-7"
1 x 3/8	9.8	.428	0'-10"	0'-10"	0'-8"	1'-6"	0'-8"	0'-6"	0'-8"
1-1/4 x 1/4	8.0	.442	0'-10"	0'-11"	0'-8"	1'-6"	0'-8"	0'-6"	0'-8"
1-1/4 x 5/16	10.2	.551	0'-11"	0'-10"	0'-9"	1'-10"	0'-9"	0'-7"	0'-9"
1-1/4 x 3/8	11.9	.666	1'-0"	1'-0"	0'-10"	2'-2"	0'-9"	0'-8"	0'-11"
1-1/2 x 1/4	9.5	.639	0'-11"	1'-0"	0'-10"	2'-1"	0'-9"	0'-8"	0'-11"
1-1/2 x 5/16	11.9	.796	1'-0"	1'-1"	0'-11"	2'-5"*	0'-10"	0'-9"	1'-1"
1-1/2 x 3/8	14.1	.959	1'-2"	1'-2"	1'-0"	2'-8"*	1'-0"	0'-10"	1'-3"
1-3/4 x 1/4	10.9	.870	1'-1"	1'-1"	1'-0"	2'-8"	0'-11"	0'-10"	1'-2"
1-3/4 x 5/16	13.8	1.088	1'-3"	1'-3"	1'-2"	3'-1"*	1'-0"	0'-11"	1'-5"
1-3/4 x 3/8	16.3	1.299	1'-4"	1'-5"	1'-3"	3'-4"*	1'-2"	1'-1"	1'-8"
2 x 1/4	12.3	1.136	1'-3"	1'-4"	1'-2"	3'-4"*	1'-1"	1'-0"	1'-6"
2 x 5/16	15.6	1.414	1'-5"	1'-6"	1'-4"	3'-9"*	1'-3"	1'-2"	1'-10"
2 x 3/8	18.5	1.700	1'-7"	1'-8"	1'-7"	4'-1"*	1'-5"	1'-4"	2'-2"
2-1/2 x 1/4	15.3	1.768	1'-8"	1'-8"	1'-7"	4'-8"*	1'-5"	1'-5"	2'-3"
2-1/2 x 5/16	19.2	2.217	1'-10"	2'-0"	1'-11"	5'-3"*	1'-8"	1'-8"	2'-9"
2-1/2 x 3/8	22.8	2.659	2'-1"	2'-3"	2'-3"	5'-9"*	1'-11"	2'-0"	3'-3"
3 x 1/4	18.1	2.550	2'-0"	2'-2"	2'-2"	6'-2"*	1'-11"	1'-11"	3'-2"
3 x 5/16	22.8	3.189	2'-4"	2'-7"	2'-7"	6'-11"*	2'-3"	2'-4"	3'-11"
3 x 3/8	27.2	3.828	2'-7"	3'-0"	3'-0"	7'-7"*	2'-7"	2'-9"	4'-8"
3-1/2 x 1/4	21.0	3.468	2'-5"	2'-9"	2'-9"	7'-9"*	2'-5"	2'-6"	4'-3"
3-1/2 x 5/16	26.4	4.338	2'-10"	3'-4"	3'-4"	8'-8"*	2'-11"	3'-1"	5'-3"
3-1/2 x 3/8	31.5	5.209	3'-3"	3'-10"	4'-0"	9'-6"*	3'-5"	3'-7"	6'-3"
4 x 1/4	23.9	4.536	2'-11"	3'-3"	3'-6"	9'-6"*	3'-0"	3'-2"	5'-6"
4 x 5/16	30.0	5.664	3'-6"	4'-2"	4'-3"	10'-8"*	3'-8"	3'-11"	6'-10"
4 x 3/8	35.8	6.800	4'-0"	4'-10"	5'-1"	11'-8"*	4'-4"	4'-8"	7'-7"*
5 x 1/4	29.7	7.086	4'-2"	5'-0"	5'-3"	13'-4"*	4'-6"	4'-10"	8'-6"
5 x 3/8	44.5	10.628	5'-10"	7'-3"	7'-9"	16'-3"*	6'-6"	7'-1"	10'-8"*
5 x 1/2	58.9	14.160	7'-6"	9'-5"*	9'-5"*	18'-10"*	8'-6"	9'-1"*	12'-3"*
6 x 1/4	35.5	10.200	5'-7"	7'-0"	7'-5"	17'-6"*	6'-3"	6'-10"	11'-5"*
6 x 3/8	53.1	15.300	8'-0"	10'-2"	10'-8"*	---	9'-2"	10'-1"	14'-0"*
6 x 1/2	70.5	20.400	10'-8"*	11'-10"*	12'-4"*	---	11'-3"*	11'-11"*	16'-2"*

Span limited by deflection.

11

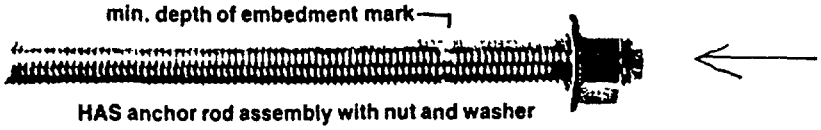
HILTI

Product Technical Guide

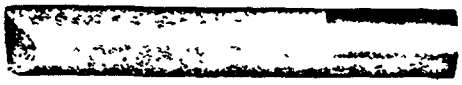
The Hilti HVA Adhesive Anchor System

Product Details

HEA adhesive capsule



HAS anchor rod assembly with nut and washer



Internally Threaded

HFA Insert

The HVA anchor system has two components, each sold separately; the HEA capsule and HAS rod, or HEA capsule and HFA insert.

Advantages

Anchor fastening does not exert expansion pressure
High loading capacity
Good performance under dynamic load
Easy to use, self-contained adhesive capsule
Fast cure time

Material

Standard HAS rod material meets the requirements of ASTM A36
High strength or 'Super HAS' rod material meets the requirements of ASTM A193, Grade B7
Stainless HAS rod material meets the requirements of ASTM F593 (AISI 304)
HAS Standard Nut — ASTM A563, Grade A
HAS Super Nut — ASTM A563, Grade DH
HAS Stainless Steel Nut — ASTM F594
HAS Standard Washer — ANSI B18.22.1 (1965) Type A Plain
HAS Super Washer — ASTM F436
HAS Stainless Steel Washer — ANSI B18.22.1 (1965) Type A Plain
All standard HAS and HAS Super Rods (except 7/8), HFA inserts, nuts and washers are plated to ASTM B633 SC1.
7/8" hot dipped galvanized in accordance with ASTM A153-78.
HEA Adhesive — Vinylester Resin with a Dibenzoyl Peroxide Hardener

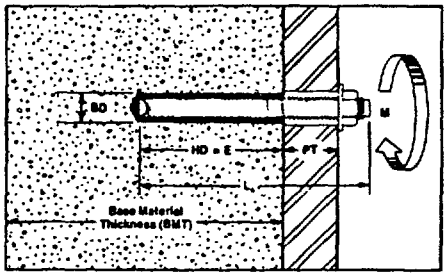
Mechanical Properties		
Anchor	Yield (KSI)	UTS (KSI)
HAS Std. 3/8"-1 1/4"	36	60
HAS-Super 3/8"-1 1/4"	105	125
HAS-SS 3/8-5/8	65	100-150
HAS-SS 3/4	45	85-140
HFA 3/8 & 1/2	63	78
HFA 5/8 & 3/4	58	71

HEA Cartridge Volumes	
Size	Volume (cu. in.)
HEA 3/8"	0.33
HEA 1/2"	0.57
HEA 5/8"	1.21
HEA 3/4"	2.53
HEA 7/8"	2.92
HEA 1"	3.73
HEA 1 1/4"	15.26

Hilti HVA Adhesive Anchor System continued

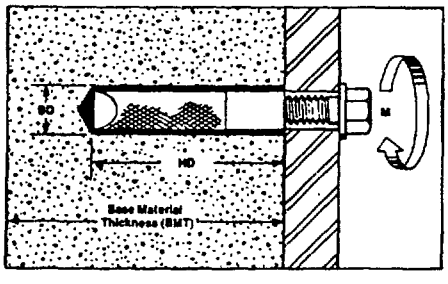
Specification Table

HAS Anchor Rod



Details		Anchor size	HAS 3/8"	HAS 1/2"	HAS 5/8"	HAS 3/4"	HAS 7/8"	HAS 1"	HAS 1 1/4"
BD	bit diameter (inches)		15/32	9/16	11/16	7/8	1	1 1/8	1 1/2
HD = E	min. depth of embedment = capsule length (inches)		3 1/2	4 1/4	5	6 5/8	6 5/8	8 1/4	12
PT	max. thickness fastened (inches)		1	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4
L_A	anchor length (inches)		5 1/8	6 1/2	7 5/8	9 5/8	10	12	16
Tensile Stress Area (in²)			0.078	0.142	0.226	0.334	0.462	0.606	0.969
M	max. tightening torque (ft. lbs.)	HAS S.S.	18	30	75	150	175	235	400
		HAS Std. HAS-Super	18	35	80	160	200	330	550
Drill bit size			TE-C + 15/32-12	TE-C + 9/16-12	TE-C + 11/16-12	TE-FY 7/8-13	TE-FY 1-18	TE-FY 1 1/8-17	TE-FY 1 1/2-23
BMT	min. base material thickness (inches)		5 1/2	6 1/4	7 1/8	8 1/2	8 1/2	10 1/2	15

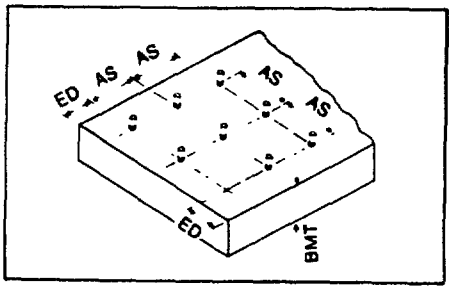
HFA Insert



Details[1]		Anchor size	HFA 3/8"	HFA 1/2"	HFA 5/8"	HFA 3/4"
BD	bit diameter (inches)		5/8	11/16	1	1 1/8
HD =	min. depth of embedment = capsule length (inches)		3 1/2	4 1/4	5	6 5/8
Useable Thread Length (inches)			1 1/2	1 1/2	2 1/16	2 1/2
M =	max. tightening torque (ft. lbs.)		18	35	80	160
Drill bit size			TE-C+ 5/8-12	TE-C+ 11/16-12	TE-FY 1-13	TE-FY 1 1/8-17
BMT	min. base material thickness (inches)		5 1/2	6 1/4	7 1/8	8 1/2

NOTE: 1. This information does not pertain to special order HFA anchors. (Drill-bit diameters and capsule sizes may vary)

Anchor Spacing and Edge Distance Guidelines (HAS Rod and HFA Insert)



Details		Anchor size	HVA 3/8"	HVA 1/2"	HVA 5/8"	HVA 3/4"	HVA 7/8"	HVA 1"	HVA 1 1/4"
AS_{cr}	spacing required to obtain maximum working load (inches)		3 1/2	4 1/4	5	6 5/8	6 5/8	8 1/4	12
AS_{min}	Minimum allowable spacing between anchors (inches) Refer to note 1		1 3/4	2 1/8	2 1/2	3 1/4	3 1/4	4 1/8	6
ED_{cr}	Edge distance required to obtain maximum working load (inches)		5 1/4	6 3/8	7 1/2	10	10	12 3/8	18
ED_{min}	Minimum allowable edge distance (inches) Refer to notes 2 and 3		1 3/4	2 1/8	2 1/2	3 1/4	3 1/4	4 1/8	6

NOTES:
1. When using AS_{min} reduce the working load by 30%.
2. When using ED_{min} and the load is a shear load, reduce the working load by 50%.
3. When using ED_{min} and the load is a tensile load, reduce the working load by 40%.

The HVA Anchor Spacings and Edge Distances for the embedment depths listed above were calculated using the following information:

	Anchor Spacing Tension And Shear			Edge Distance Shear Load Only			Edge Distance Tension Load Only		
	AS_{cr}	AS_{min}	f_{AS}	ED_{cr}	ED_{min}	f_{ED}	ED_{cr}	ED_{min}	f_{ED}
HVA	1.0E	0.5E	0.7	1.5E	0.5E	0.5	1.5E	0.5E	0.6

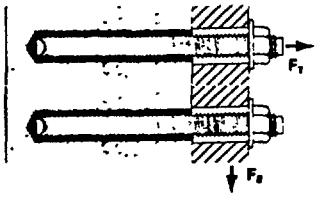
1. Use linear interpolation between critical and minimum. AS or ED to determine load factor.

Hilti HVA Adhesive Anchor System continued

HVA Allowable Bond Strength and Steel Strength for HAS Rods[2]

Anchor Diameter (in.)	Embed. Depth (in.)	Adhesive Capsule(s) Required	HEA Tensile Bond Strength (lbs) 2000 psi Conc.	3000 psi Conc.	4000 psi Conc.	6000 psi Conc.	Steel Strength (lbs) HAS Std. [1]Tensile	HAS Std. [4]Shear	HAS Super [1]Tensile	HAS Super [4]Shear	HAS SS (304 SS) [1]Tensile	HAS SS (304 SS) [4]Shear
3/8	3 1/2	1 - 3/8 x 3 1/2	2010	2210	2420	2830	1560	1070	3250	1900	2600	1850
	5 1/4	2 - 3/8 x 3 1/2	3010	3320	3630	4250						
	7	2 - 3/8 x 3 1/2	4010	4425	4840	5665						
1/2	4 1/4	1 - 1/2 x 4 1/4	2660	2990	3330	3990	2840	2090	5920	3270	4730	3600
	6 3/8	1 - 1/2 x 4 1/4 & 1 - 3/8 x 3 1/2	4000	4490	4990	5980						
	8 1/2	2 - 1/2 x 4 1/4	5330	5990	6650	7970						
5/8	5	1 - 5/8 x 5	4120	4590	5070	6020	4520	3000	9420	5632	7530	5050
	7 1/2	1 - 5/8 x 5 & 1 - 1/2 x 4 1/4	6180	6890	7600	9030						
	10	2 - 5/8 x 5	8240	9190	10140	12040						
3/4	6 5/8	1 - 3/4 x 6 5/8	5750	6510	7260	8770	6680	4800	13920	7650	9460	7270
	10	1 - 3/4 x 6 5/8 & 1 - 1/2 x 4 1/4	8630	9760	10890	13150						
	13 1/4	2 - 3/4 x 6 5/8	11510	13020	14520	17530						
7/8	6 5/8	1 - 7/8 x 6 5/8	6770	7660	8550	10320	9240	6350	19250	10780	(3)	(3)
	10	2 - 3/4 x 6 5/8	10160	11490	12820	15490						
	13 1/4	2 - 7/8 x 6 5/8	13540	15320	17090	20650						
1	8 1/4	1 - 1 x 8 1/4	9640	10960	12290	14930	12120	7630	25250	13760	(3)	(3)
	12 3/8	2 - 7/8 x 6 5/8	14460	16450	18430	22390						
	16 1/2	2 - 1 x 8 1/4	19280	21930	24570	29860						
1 1/4	12	1 - 1 1/4 x 12	20510	23220	25940	31370	19380	13070	40375	21530	(3)	(3)
	15	1 - 1 1/4 x 12 & 1 - 1 x 8 1/4	24935	27535	30140	35340						
	18	1 - 1 1/4 x 12 & 2 - 1 x 8 1/4	29360	31850	34340	39310						

1. Allowable tensile load for anchor rods is based upon allowable stress = .33 Fu (ultimate tensile strength) acting upon the tensile stress area of the rods. Reference AISC Steel Manual Section 1.5
2. **Use lower value of either bond or steel strength for tensile load.**
3. 7/8-1 1/4 HAS SS only available through special order, no test data available.
4. Values obtained from test data at min. embedment.



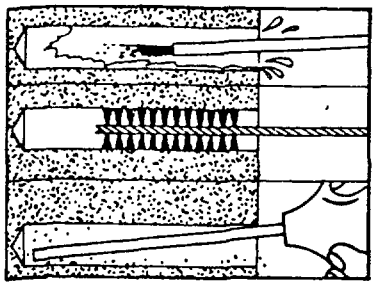
HVA Ultimate Bond Strength and Steel Strength for HAS Rods[2]

Anchor Diameter (in.)	Embed. Depth (in.)	Adhesive Capsule(s) Required	HEA Tensile Bond Strength (lbs) Concrete Strength 2000 psi	3000 psi	4000 psi	6000 psi	Steel Strength (lbs)[1] HAS Std. Yield Strength	HAS Std. Tensile Strength	HAS Std. [4]Shear Strength	HAS Super Yield Strength	HAS Super Tensile Strength	HAS Super [4]Shear Strength	HAS SS (304 SS) Yield Strength	HAS SS (304 SS) Tensile Strength	HAS SS (304 SS) [4]Shear Strength
3/8	3 1/2	1 - 3/8 x 3 1/2	7530	8300	9070	10620	2810	4680	4015	8190	9750	7120	5070	7800	6930
	5 1/4	2 - 3/8 x 3 1/2	11290	12450	13610	15930									
	7	2 - 3/8 x 3 1/2	15050	16600	18140	21240									
1/2	4 1/4	1 - 1/2 x 4 1/4	9990	11230	12470	14950	5110	8520	7850	14910	17750	12280	9230	14200	13490
	6 3/8	1 - 1/2 x 4 1/4 & 1 - 3/8 x 3 1/2	14980	16840	18700	22420									
	8 1/2	2 - 1/2 x 4 1/4	19980	22460	24930	29890									
5/8	5	1 - 5/8 x 5	15440	17220	19010	22570	8140	13560	11240	23730	28250	21120	14690	22600	18950
	7 1/2	1 - 5/8 x 5 & 1 - 1/2 x 4 1/4	23160	25840	28510	33860									
	10	2 - 5/8 x 5	30890	34450	38010	45140									
3/4	6 5/8	1 - 3/4 x 6 5/8	21580	24400	27230	32870	12020	20040	18010	35070	41750	28700	15030	28390	27250
	10	1 - 3/4 x 6 5/8 & 1 - 1/2 x 4 1/4	32370	36600	40840	49310									
	13 1/4	2 - 3/4 x 6 5/8	43160	48810	54450	65740									
7/8	6 5/8	1 - 7/8 x 6 5/8	25390	28720	32050	38710	16630	27720	23805	48510	57750	40410	(3)	(3)	(3)
	10	2 - 3/4 x 6 5/8	38090	43080	48080	58070									
	13 1/4	2 - 7/8 x 6 5/8	50780	57440	64100	77420									
1	8 1/4	1 - 1 x 8 1/4	36160	41110	46070	55980	21820	36360	28615	63630	75750	51590	(3)	(3)	(3)
	12 3/8	2 - 7/8 x 6 5/8	54230	61670	69100	83970									
	16 1/2	2 - 1 x 8 1/4	72310	82230	92140	111970									
1 1/4	12	1 - 1 1/4 x 12	76910	87080	97260	117620	34880	58140	49000	101745	121125	80740	(3)	(3)	(3)
	15	1 - 1 1/4 x 12 & 1 - 1 x 8 1/4	93505	103255	113025	132525									
	18	1 - 1 1/4 x 12 & 2 - 1 x 8 1/4	110100	119430	128760	147420									

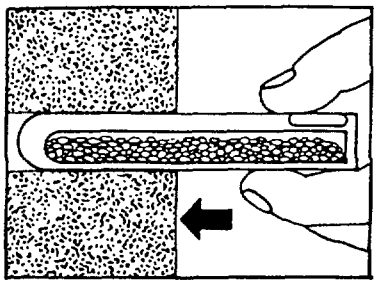
1. Steel strength based on tensile stress area of standard UNC thread.
2. **Use lower value of either bond or steel strength for tensile load.**
3. 7/8-1 1/4 HAS SS only available through special order, no test data available.
4. Values obtained from test data at min. embedment

Hilti HVA Adhesive Anchor System continued

Installation Instructions — HAS Rod and HFA Insert



1. Set the drill depth gauge and hammer drill the hole to the required hole depth. IMPORTANT: Clear out dust and fragments; preferably using a jet of water or compressed air and a wire brush. The hole may be damp, but the standing water should be blown out.

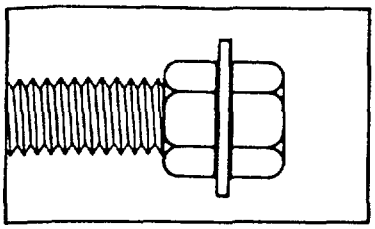


2. Insert appropriate diameter HEA adhesive capsule into pre-drilled hole in base material. Note: When installing a 1 1/4" diameter HEA capsule, the end with the sealing cap should be pointed into the hole.

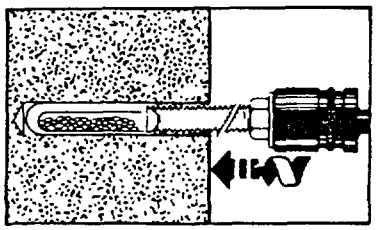
Curing Time		Base Material Temperature
3/8-1" ϕ	1 1/4" ϕ	
20 Min.	40 Min.	Above 68°F
30 Min.	1 Hr.	50°F
1 Hr.	2 Hr.	32°F
5 Hr.	5 Hr.	23°F

Below 23°F, consult your Hilti Engineer

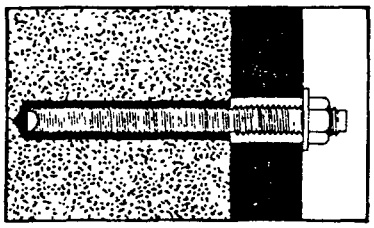
HAS Rod



3. HAS
Thread a nut on the HAS rod. Place a washer on top of the first nut and then thread a second nut down on top of the washer. Tighten the two nuts together "locking" the washer between them. The top nut should be flush with the top of the rod.

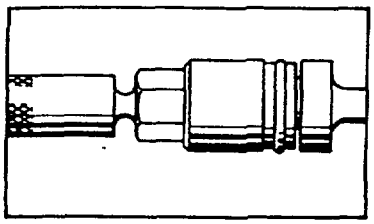


4. HAS
Insert square drive shaft into hammer drill. Attach proper impact socket. At the rotary hammer drill setting engage the top nut of the HAS rod assembly with the socket and drive the rod in to the embedment mark.

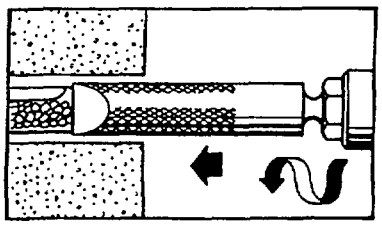


5. HAS
The set anchor rod may not be disturbed or loaded before the specified curing time.

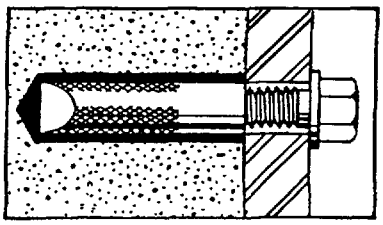
HFA Insert



3. HFA
Insert the shaft with socket into the hammer drill, screw the setting tool into the HFA and place in the socket.



4. HFA
At the rotary hammer drill setting, drive the HFA to flush with the surface of the concrete. Remove setting tool.



5. HFA
The set anchor can not be disturbed or loaded before the specified curing time.

HVA Allowable Bond Strength and Steel Strength for HFA Inserts[3]

Anchor Diameter (in.)	Embedment Depth (in.)	Adhesive Capsule Required	HEA Bond Strength (lbs)				Steel Strength (lbs)	
			2000 psi Concrete	3000 psi Concrete	4000 psi Concrete	6000 psi Concrete	Tension[2]	Shear[2]
3/8	3 1/2	1 - 3/8 x 3 1/2	2010	2210	2420	2830	2880[1]	1820
1/2	4 1/4	1 - 1/2 x 4 1/4	2660	2990	3330	3990	3690	2635
5/8	5	1 - 5/8 x 5	4120	4590	5070	6020	7295[1]	5055
3/4	6 5/8	1 - 3/4 x 6 5/8	5750	6510	7260	8770	9750	7315

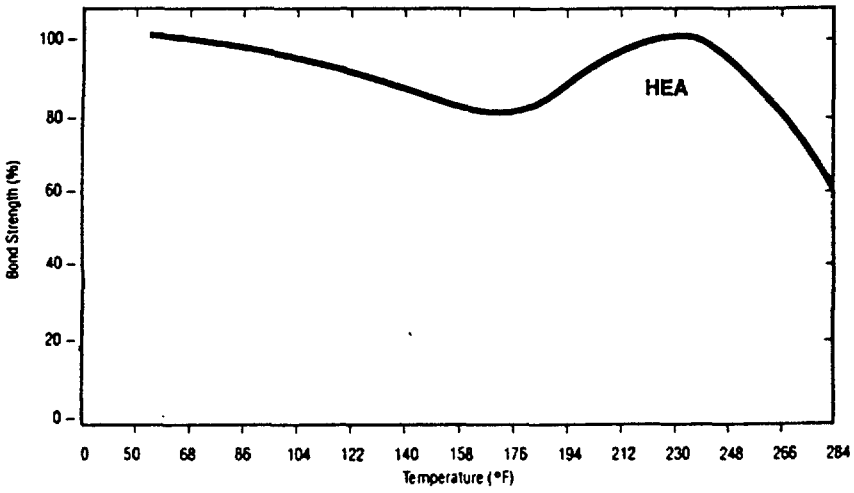
1. HEA adhesive capsule will not completely fill the annular gap.
2. Values obtained using SAE Grade 5 bolts. (fy = 85 Ksi, Fult = 120 Ksi)
3. **Use lower value of either bond or steel strength for tensile load.**

HVA Ultimate Bond Strength and Steel Strength for HFA Inserts[3]

Anchor Diameter (in.)	Embedment Depth (in.)	Adhesive Capsule Required	HEA Bond Strength (lbs)				Steel Strength (lbs)	
			2000 psi Concrete	3000 psi Concrete	4000 psi Concrete	6000 psi Concrete	Tension[2]	Shear[2]
3/8	3 1/2	1 - 3/8 x 3 1/2	7530	8300	9070	10620	10810[1]	6827
1/2	4 1/4	1 - 1/2 x 4 1/4	9990	11230	12470	14950	13830	9890
5/8	5	1 - 5/8 x 5	15440	17220	19010	22570	27365[1]	18965
3/4	6 5/8	1 - 3/4 x 6 5/8	21580	24400	27230	32870	36560	27405

1. HEA adhesive capsule will not completely fill the annular gap.
2. Values obtained using SAE Grade 5 bolts. (fy = 85 Ksi, Fult = 120 Ksi)
3. **Use lower value of either bond or steel strength for tensile load.**

Influence of Temperature on Bond Strength



Note: Test procedure involves the concrete being held at the elevated temperature for 24 hours then removing it from the oven and testing to failure.